Finally, 'Tis worth obſerving, that this Varniſh has this known power; for having ſpread ſome of it on the naked Breaſt of ſome Fowls, leaving it ſticking there for three days, I afterwards found between the dryed Varniſh and the Fleſh the place all feſtered, and full of a yellowiſh Serum and Matter, but without any farther miſchief to the Body of the Fowls themſelves. I have attempted the ſame thing in Dogs and Cats, but without ſucceſs, for theſe Animals with their tongues and claws ſoon take off all the Varniſh from their Bodies, and ſo have no hurt by it. Poſſibly in Horſes and like Beaſts the Experiment may ſucceed better, if the Varniſh has this corroſive or Cauſtic quality upon their Bodies as it has on Poultry.

IV. *Obſervations upon the Diſſolutions and Fermentations which we may call Cold, becauſe they are accompanied with a Coolneſs of the Liquors into which they paſs. And of a new Thermometer. Extracted out of a Diſcourſe, which Mr* Geoffroy, *F. R. S. made in the Public meeting of the Royal Academy of Sciences, the 21ſt of* April, *1700.*

THe different Searches which I have made about the Nature and Propriety of Salts (in order to acquit my ſelf of the Promiſe I had made of taking ſome pains in this matter, when I had the Honour to be admitted into this Society) and the different Experiments which I have tryed, in examining their Diſſolutions or Mixtures in certain Liquors, have given me occaſion to obſerve, that the Mixture of the greateſt part of the Salts in many Liquors is accompanied with a ſenſible Coldneſs of the Liquors, notwithſtanding the prompt and violent Fermentations which follow many of theſe Mixtures.

I have diſtinguiſh'd theſe Diſſolutions or Mixtures into two Claſſes. In the former I comprehend all the Simple Cold Diſſolutions; that is to ſay, Thoſe Diſſolutions which are not accompanied with any ſenſible Ferment. The ſecond takes in only the Cold Ferments, or Diſſolutions of Salts, which are accompanied with a ſenſible Ferment, and a Coldneſs of the Liquor.

CLASS I.

Of Simple Cold Diſſolutions.

Diſſolution of Salts ſalted in common water.

I Put a pint of common Water into a Viol, and an ordinary Thermometer of 18 inches in the Water, and ſo let it lie ſome time to fit itſelf in proportion to the Temperature of the Water. I afterwards put into the Water 4 ounces of *Sal Armoniac*, and the Liquor of the Thermometer deſcended two inches and 9 lines, in leſs than a quarter of an hour.

Obſerving the ſame Circumſtances, I made the ſame Experiment with Salt-Peter, and the Liquor of the Thermometer deſcended 1 inch 3 lines.

The ſame Experiment being made with Vitriol, the Liquor of the Thermometer deſcended almoſt an inch.

Sea-Salt made the Liquor deſcend but 2 lines. And all the Salts being to be put in very lightly, I thought it the hardeſt matter to pour it in aright.

Diſſolution of Alkali Volatil Salted in common water.

All the Alkali Volatile Salts cooled the Common Water by their mixture, cauſing the Liquor of the Thermometer to deſcend by ſome Lines: But I obſerved that they cauſed it (to do ſo) more or leſs, according as they were more or leſs purified: And the Salt of Urine ſeem'd to do ſo ſooneſt of all.

Alkalous Lixivious Salts excepted from the general Rule, becauſe that ſome of them do Heat in their mixture with water.

As for the Alkali Lixivious Salts, they were ſo far from cooling the Water in which they were mingled, that they heated it more or leſs, according as they were Calcined better or worſe.

Upon the whole, one may obſerve that the Salts for Heating the Water ought to be purely Alkalous. For if they approach near the nature of Nitre or Sea-Salt, they Heat the Water but a little, or not at all, if they do not rather Cool it. This is alſo done very conſiderably by the Salt of Tamariſc, extracted from the *Lixivium* of the Aſhes of this Vegetable.

Salts ſalted, mixed with the Acids of Vegetables.

Sal Armoniac mingled with the Acids of Vegetables, as diſtilled Vinegar, Juice of Limons or Verjuice, gave no mark of a Ferment, but cool'd theſe Liquors very much.

An ounce of *Sal Armoniac* caſt into 4 or 5 ounces of Diſtilled Vinegar cauſes the Liquor of the Thermometer to deſcend 2 inches 3 lines.

The ſame Salt, mixed with the Juice of Limons, cauſed the Liquor to deſcend 2 inches. It does the ſame with Verjuice.

Theſe are the mixtures of Salts with Liquors, which ſeem'd moſt remarkable, by reaſon of the Cold which they excited. Let us now treat of thoſe which are accompanied with Fermentations.

CLASS II.

Of Cold Fermentations.

Salts ſalted, mixt with Acid Spirits.

SAlt-Peter caſt into its Acid Spirit raiſed ſome Smoke or Vapours, and cauſed the Liquor of the Thermometer to deſcend 4 lines.

Salt-Peter, mixed with Spirit of Vitriol, Smoke exhaled in great quantity, and cauſed the Liquor to deſcend from 6 to 7 lines. In theſe two Experiments I put half an ounce of Salt upon 3 ounces of Liquor.

I put half an ounce of *Sal Armoniac*, into 3 ounces of Spirit of Nitre, and the Liquor of the Thermometer deſcended 2 inches 5 lines. This Mixture put forth ſome Vapours, which ſeem'd more conſiderable than thoſe which do ordinarily exhale from Spirit of Nitre alone.

I poured half an ounce of *Sal Armoniac* into 3 ounces of Spirit of Vitriol,which made a violent Fermentation. The Subject Matter was conſiderably raiſed; and much Vapour went out, the Liquor was very thick, and the Thermometer deſcended 3 inches 6 lines. I obſerved, that the Vapours which were raiſed by this Mixture were Hot, and that they conſiderably raiſed the Liquor of the Thermometer, which I held hanging above the Subject Matter, tho that which was dipp'd within did deſcend, and ſhew'd a very great Cold.

Sea Salt excepted.

Sea-Salt mixed with Acid Spirits, Heats the Liquors, inſtead of Cooling them.

Being mixed with Spirit of Salt, it raiſed the Liquor of the Thermometer ſome lines, without ſhewing any ſenſible Ferment.

With Oil of Vitriol it ferments with a Noiſe, and raiſes a great ſmoke : the Liquor thickens, and becomes a ſort of a clear Jelly. The Liquor of the Thermometer riſes very much in this Mixture, and the Heat is ſenſible to the Touch.

Volatile Alkalous Salts mingled with Acid Spirits.

All the Volatile Alkalous Salts mingled with different Acid Liquors, excited a Ferment more or leſs ſtrong, according to the Acidity of the Liquors, and the Purification of theſe Salts from their Fetid Oils. They all made the Liquor of the Thermometer to deſcend : but that which did ſo the moſt conſiderably, is the Salt of Urine.

One ounce of Volatile Salt of Urine very well Rectified, in 4 ounces in Diſtilled Vinegar, made a ſtrong Fermentation. The ſubſtance is elevated very much, and with noiſe ; and the Liquor of the Thermometer deſcends in the Ferment one inch 9 lines.

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One ounce of Volatile Salt of Urine, in 3 ounces of Spirit of Vitriol, raiſed a violent Ferment, during which the Liquor of the Thermometer deſcended 2 inches 4 lines.

Fixed Salts purely Acid excepted.

The mixture of Salt of Tartar, or other fix'd Alkalous pure Salts, with Acid Liquors excited Fermentations with Heat.

I made all theſe Experiments with the ſame Thermometer, when the Weather was ſufficiently Cold, and the Temperature of the Air equal enough.

Reaſon of the Cold and Diſſolution of Salts.

As to the Reaſon of theſe Experiments, I firſt of all examined the ſimple Cold Diſſolutions, and having (with all Phyſicians) fixed this Principle, That Cold is nothing but the Diminution of motion; I ſay, that the Coldneſs which the Salts bring to the Water, ſeems to be occaſion'd from this, that the Salt Particles being without motion, and dividing that Liquor, diminiſhes it ſo much the more. This (is that) which produces the Cold greater or leſs in the ſame Liquor.

Why the Thermometer riſes a little, the diſſolution being made.

There is one thing to be obſerved, which is, that ſome time after the Diſſolution is made, the Liquor of the Thermometer riſes again a little. Which may be occaſioned by this, that the ſubtil matter which glided abundantly between the Liquid Particles, had ceas'd to glide there in the ſame quantity for ſome time, the groſs Particles of the Salts oppoſing themſelves againſt their Paſſage; but theſe Saline Particles being divided by little and little, they opened again the paſſages to the ſubtil matter. This gave to the Liquor more Motion than it had at the beginning of the Diſſolution; but yet leſs than it had when it was pure and without mixture; the Saline Particles, altho diſſolv'd abating ſomewhat of their motion.

Whence proceeds the Heat of the Diſſolutions of Lixivious Salts

We may eaſily comprehend why Lixivious Salts, purely Alkalous and well Calcin'd, as alſo the Salt of Tartar do Heat the Liquor, and are very far from Cooling it, if we conſider that theſe Salts in the ſtrong calcination which they

they have undergone, are loaded with many Fiery Particles which they hold, as it were in Priſon, in their Pores. Theſe Igneous Particles regain their Liberty by the Diſſolution of the Saline Particles. And in the ſame time that theſe Salts ought to ſlacken the Motion of the Aqueous Particles, and cool it, the Igneous Particles being very active, do augment the Agitation of the Watry Particles till they make it very hot.

Great Coldneſs of Sal Armoniac even to Freezing

I obſerve next, that *Sal Armoniac* cools the Water wherein it is Diſſolved, more than any other Salt. Its Cold equals that of Water which is ready to Freeze. And it happen'd one time, that in Diſſolving a good quantity of this Salt in Water, ſome Drops which fell on the outſide of the Viol in which I made the Diſſolution did Freeze, and the Straw upon which the Viol ſtood, being wet, was faſtned to the Glaſs-Veſſel, for ſome time, by the Ice. This fell out ſince the Summer, at a time when the Weather was warm.

I have many times ſince tryed the ſame Experiment, in different ways, but without ever being able to produce the Ice. Chance had apparently made me meet in this Experiment, not only a very exact proportion between the Salt and the Water, but alſo a Temperature in the Water beſides, which I ſuppoſe neceſſary: becauſe the Diſſolution being quick, the Coldneſs muſt alſo be more ſudden and great: and this is that Degree of Temperature to which I could never afterwards attain.

Reaſon of the Coldneſs.

The great Coldneſs of the Diſſolution of *Sal Armoniac* proceeds not from any difficulty which it has to be Diſſolv'd, ſince it diſſolves ſooner than any other. And Sea-Salt, whoſe Diſſolution is difficult and very ſlow, is that which does leaſt cool its Diſſolver. On the contrary, it ſeems that the facility and readineſs with which it Diſſolves, may be the Cauſe of this great Cold, in this manner.

Sal Armoniac, as every body knows, is a Compoſition of Sea-Salt and Salt of Urine, the one very eaſie, the other very

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very hard to diſſolve; the Particles of Sea-Salt being, as it were, impriſoned among the Particles of the Salt of Urine, it comes to paſs, that many of the Aqueous Particles, penetrating at firſt daſh the Saline Particles of the Urine, do there immediately loſe much of their Motion; and this Motion grows weaker by ſo much the more, as the Aqueous Particles meet afterwards with Saline Particles of another Nature, whoſe Reſiſtance is much more conſiderable, than that of the Salts of Urine. So in the firſt Inſtance of the Diſſolution, the Motion of a great quantity of Aqueous Particles being very much abated all at once, by the Salts of Urine, and by the Sea Salt, it excited, in a few moments, a Cold far greater than the Cold of other Diſſolutions of Salts, which the Water does not penetrate ſo readily.

It may be Objected, that the Sea-Salt being the hardeſt to Diſſolve, its Diſſolution would be alſo the Coldeſt. To which I anſwer, that this might be if the Water could penetrate ſuddenly into all its parts: but the ſlowneſs with which it penetrates them, becauſe of the cloſe Texture of the *Molecules* of this Salt, does hinder that the Diminution of the Motion of the Parts of the Water, can't be ſo ready, nor by conſequence ſo great: Whereas in *Sal Armoniac*, the Parts of the Sea-Salt being extended by the Salt of Urine, the Pores of the Alkalous Salt of Urine are like ſo many Ways open to the Parts of the Water, for going to penetrate the Parts of the Sea-Salt in numberleſs places.

Experiment of a Saline Diſſolution exceſſively cold.

I place in the Rank of Cold Diſſolutions, an Experiment which Monſieur *Homberg* made ſome time ago, before the Society, and which I believe will not be amiſs if I ſhould repeat it here; becauſe it ſerves to prove that which I am going to ſay about the Cold of *Sal Armoniac*; the Experiment being otherwiſe not very common. 'Tis made thus: Take a pound of Corroſive Sublimate, and a pound of *Sal Armoniac*, powder them, each apart; then mix both the Powders very exactly, put the Mixture into

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a Viol, pouring upon it a Pint and half of Diſtilled Vinegar, ſhaking it well together. This Compoſition will be ſo very Cold, that a man can hardly hold the Veſſel in his hands in Summer. And it chanced that as Monſieur *Homberg* was making this mixture, that the Subject froze.

We ſee in this Experiment a Cold yet greater than that in the Diſſolution of *Sal Armoniac* alone in Common Water. And this Cold is cauſed by the Corroſive Sublimate, which alone is not at all, or at leaſt very little Diſſoluble in Diſtilled Vinegar. So that the fluid parts of the diſtilled Vinegar having quickly penetrated the Parts of the *Sal Armoniac*, and having already loſt a great deal of their Motion, engaging afterwards in the Pores of a Body which they could not Diſſolve, and having Action not more than enough for that, they do there loſe that little Activity which they had. They coagulate there, if not at all, at leaſt the greateſt part: and this want of Action is the cauſe of that great Cold which we perceive there.

Till now, I have only conſidered Simple cold Diſſolutions of Salts, in which there is no Augmentation of a ſenſible Motion; Let us now paſs to the Diſſolutions of the ſecond Claſs, which are the cold Ferments, in which the Cold appears as a Conſequence of the Agitation of the parts of the Liquor.

Explications of Cold Ferments.

In order to ſhew the Reaſon of Cold Ferments, I own (with the Phyſicians) that Heat and Cold in Liquors are neither more nor leſs than Motion in the little parts of theſe Liquors, cauſed by the continual current of the Subtil Matter in the Spaces which theſe Particles do leave between them. And I affirm, that every time this Motion is diminiſhed, and when the Courſe of the Subtle Matter is interrupted, the Liquor appears leſs Hot or more Cold.

This being ſuppoſed, if we do attend to that which happens in Cold Fermentations, we ſhall obſerve on the one hand for the moſt part, very conſiderable Coagulations, and a very ſenſible Thickening of the Liquors: on the

the other hand, we ſhall perceive a very violent agitation of ſome of the parts of theſe mixtures: Many Vapours are exhaled, the matter ſwells, ſends out many Bubbles and Ferments with Noiſe. And in this manner I conceive that all theſe effects are produced.

In the mixture which I made of Salts with Acid Liquors, the greateſt part of the Liquor coagulating with a part of the Salts, its motion was much abated in a little time; but its parts not being able to coagulate, without ſtopping or weakning the current of the ſubtil matter; this matter finding the paſſages ſhut up, takes its courſe by the Interſtices, which remained between the Coagulated Particles, where the paſſage was yet free; and as if glided away in a quantity together, it cauſed a very conſiderable Agitation in the parts which it met with in its paſſage. 'Tis this agitation which cauſes the Fermentation which we perceive: 'Tis this which raiſes the Bubbles of Air and the Smoke: 'Tis this which puffs up and ſwells the matter with ſo much the more Violence, as all the parts of the Liquor being almoſt half coagulated, do hinder the Motion and Agitation of theſe little Particles. Nevertheleſs this Agitation, how violent ſoever it may appear, is not conſiderable enough to break the Coagulum intirely, which is formed in the Liquor, nor conſequently to overcome the Cold, which cauſes this Coagulation. All it can do, is to preſerve yet ſome kind of Fluidity. In ſhort, the more theſe mixtures are diſpos'd to coagulate, the more they excite the cold. This we may ſee in the mixture of Sal Armoniac with Oil of Vitriol, in which the Coagulum becomes ſo ſtrong, that at laſt, it forms above the Liquor a very thick Saline Cruſt. In the mixture of other Salts with weaker Acids, as in the mixture of Volatil Salts with Spirit of Vinegar, the Coagulum can hardly be perceived; nor is the Cold ſo conſiderable as in the former.

I add farther, that even the violent Agitation which this mixture cauſes, being not univerſal, and paſſing no farther than ſome few places of the Liquor; it may for all that, contribute to the great Coldneſs in the mixture of Sal Armoniac and Oil of Vitriol in encreaſing the Coagulum, ſo that the little Particles which are violently agitated in this Mixture, being not able to draw along with them in their motion the Coagulated parts which are too groſs; they drive them away from the Center of their Motion: So that theſe particles almoſt half coagulated, being got amongſt theſe little Whirl-pools, and preſs'd one againſt another, they ſtick cloſe to one another, coagulate ſtill more ſtrongly, and loſe their motion entirely; which cauſes a very great cold. If any man can ſcarce perſuade himſelf that the Violent Agitation in ſome parts of the Mixture does contribute to the Coldneſs of the Liquor, he may be convinced by the following Experiment.

Experiment of Water cooled by Fire.

I put ſome cold Water into a great Baſin, I put into the middle of the Water a Cucurbit of Glaſs full of Water equally cold. I put into the Cucurbit a very good Thermometer, which I let lie a good while for a Tryal.

When it was adjuſted to a Degree proportionable to the Cold of the Water, I threw ſuddenly into the Water in the Baſin four or five Shovels full of Coals well kindled; and in an inſtant, the Liquor of the Thermometer deſcended 2 or 3 lines. After ſome moments, the Liquor roſe again, when the Heat of the Water in the Baſin was communicated to the Veſſel of Glaſs.

Reaſon of this Experiment.

The Cold of the Water of the Cucurbit, can't be attributed to any thing beſides the Preſſion or ſudden Condenſation which the Fire cauſed in the Water, wherein it was put. Which condenſation may be explained in this manner.

In the inſtant that the burning Coals were thrown into the Water, the Vortex of the Subtil Matter by which it was turn'd round, being preſs'd by the Water which environed it, ſcatter'd with violence all the particles of the Wa-

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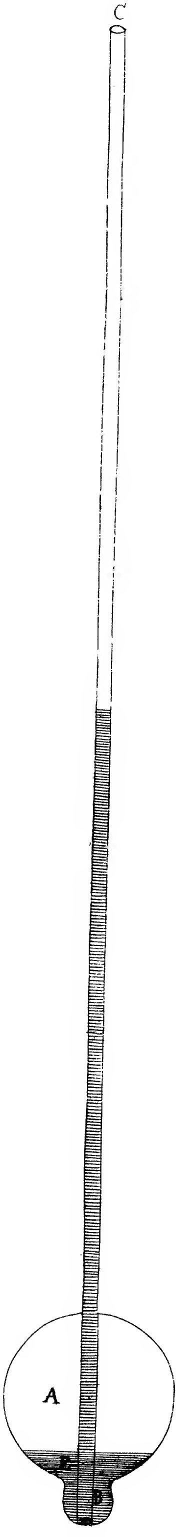

Water. This ſcattering being made all at a time in many Places of the Water in the Baſin all round the Veſſel of Glaſs: All the Particles which environ'd the Veſſel being at once preſs'd on all ſides were condenſed conſiderably and ſucceſſively. The Veſſel being in the Center of Preſſion bore all the weight of this preſſion, as well as the Liquor which contained it. And this Liquor loſt by its Condenſation very much of the motion of the Liquid, which it had before, which was conſiderable enough to cauſe the Liquor of the Thermometer to fall. This Cold goes off quickly, becauſe all the Water in the Baſin being very much heated, it quickly heats alſo that in the Veſſel of Glaſs.

The ordinary Thermometers not being capable of marking to me the Cold of the Water ſo readily and nicely as I would, in this Experiment, I had recourſe to another ſort of Thermometer which was more exact. This Thermometer is made of a Bowl of Glaſs, A, which has no other opening than that of a very long Tunnel, BC, which deſcends almoſt to the bottom of the Bowl. One end of the Tunnel is dipp'd in a Liquor E which is at the bottom of this Bowl, and the reſt is fill'd with nothing but Air. When the Air rarefies, it compreſſes the Liquor which it forces to riſe in the little Tunnel. And when it condenſes it gives the Liquor liberty to fall. This Thermometer is more ſenſible than any other, becauſe the Air which is its Mover, does rarefie with Heat, and condenſes with Cold, ſooner than any Liquid.

Reaſons of the Hot Vapours from the Cold Ferment cauſ'd by the mixture of Sal Armoniac and Oil of Vitriol.

As for the ſenſible Heat of the Vapours which riſe from the Mixture of *Sal Armoniac* with Oil of Vitriol; it is not difficult to find the Cauſe, if we conſider that theſe Vapours are but the moſt ſubtil and active parts of this Mixture, which the ſubtil Matter raiſes with in it croſſing it. The Motion of theſe Particles is free in the Air; it is but more repreſſed by the too groſs coagulated Particles. It becomes by ſo much the more violent, by how much it has been retain'd and Hindred for ſome time; and is perceived by Heat, which is the ordinary Effect of rapid and violent motion.

I will relate another conſiderable Experiment of the Cold Fermentation cauſed by the Mixture of *Sal Armoniac* and Oil of Vitriol.

Change of the Cold Ferment from the mixture of Sal Armoniac and Oil of Vitriol, into a very hot Ferment with a little Water.

If after having made the Mixture of 4 ounces of Oil of Vitriol, and an ounce of *Sal Armoniac*, one throws upon it a ſpoonful of common Water, in the time when the Fermentation is ſtrongeſt, the Cold is greateſt, and the Thermometer falls with the greateſt quickneſs, the Ferment ceaſes, and the Cold changes immediately into a great Heat, and makes the Liquor of the Thermometer to riſe very high.

. One may eaſily conceive the Reaſon of this Experiment, if we conſider that the Water heating quickly and ſtrongly with the Oil of Vitriol, makes here the ſame Effect. And this Heat is ſufficiently great, at that time to deſtroy the Cold of the coagulated Particles, the Water by it ſelf being otherwiſe very proper to diſſolve this *Coagulum.*

It remains, that I give an account why Sea-Salt heats with different Acid Liquors: but as to that, we ought to enquire into the Nature of this Salt, which would carriey us too far.

I will only ſay before I make an end, that I do not here pretend to enumerate exactly all the Cold Diſſolutions and Fermentations; I have related only the Experiments which I have made upon the Salts and Liquors which we ofteneſt uſe, and which I thought moſt conſiderable. As to the Reaſons which I have given of theſe Cold Diſſolutions and Fermentations; I advance them only as Conjectures, which I ſubmit to the Judgment of Phyſicians, who underſtand theſe matters better than I do.

The New Thermometer, whoſe Effects is more quick than that of Ordinary Thermometers.

IT's compoſed of a Bowl or Bottle of Glaſs, which has no opening, but by a little Tunnel at the end; and which deſcends to the bottom. This Tunnel is open at both ends B C. B dips into the Liquor E which is at the bottom of the Bowl.

The ſpace of the Bottle of Glaſs is fill'd with Air, which has no Communication with the Exterior Air.

When the Air contain'd in this Space is rarefied by the exterior Air which touches the Bottle, it preſſes at the ſame time the Liquor E, and obliges it to riſe by B in the Tunnel B C. On the contrary, when it Condenſeth by the Exterior Cold, by not preſſing the Liquor E, it permits that which is in the Tunnel to Fall.

The Readineſs with which the Air Condenſes or Rarefies by Cold and to Heat, makes the Effects of this Thermometer much more ſudden than thoſe of any other ſort. Beſides, the Effects of this is much greater, the Air being more capable of a great Rarefaction, or of a great Condenſation, than any other Liquor.

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